

# HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

Twenty-first Progress Report  
1 April 2006 to 30 June 2006

Hydrometeorological Design Studies Center  
Hydrology Laboratory

Office of Hydrologic Development  
U.S. National Weather Service  
National Oceanic and Atmospheric Administration  
Silver Spring, Maryland

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## DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk.

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# HAWAII PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 43*

## 1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development of NOAA's National Weather Service plans to update its precipitation frequency estimates for Hawaii. Current precipitation frequency estimates for Hawaii are contained in *Technical Paper No. 43*, "Rainfall-Frequency Atlas of the Hawaiian Islands for Areas to 200 Square Miles, Durations to 24 Hours, and Return Periods from 1 to 100 Years" (U.S. Weather Bureau, 1962) and *Technical Paper No. 51*, "Two- to Ten-Day Rainfall for Return Periods of 2 to 100 Years in the Hawaiian Islands" (U.S. Weather Bureau, 1965). The update includes collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project will determine annual precipitation frequencies for durations from 5 minutes to 60 days, for average recurrence intervals from 1 to 1,000 years. The project will review and process rainfall data for the project area and use accepted statistical methods. The project results will be published as Volume 4 of NOAA Atlas 14 on the Internet (<http://www.nws.noaa.gov/ohd/hdsc>) using web pages with the ability to download digital files.

The project area covers the Hawaiian Islands including Hawaii, Maui, Lanai, Molokai, Oahu, and Kauai. The project area including preliminary regions is shown in Figure 1.

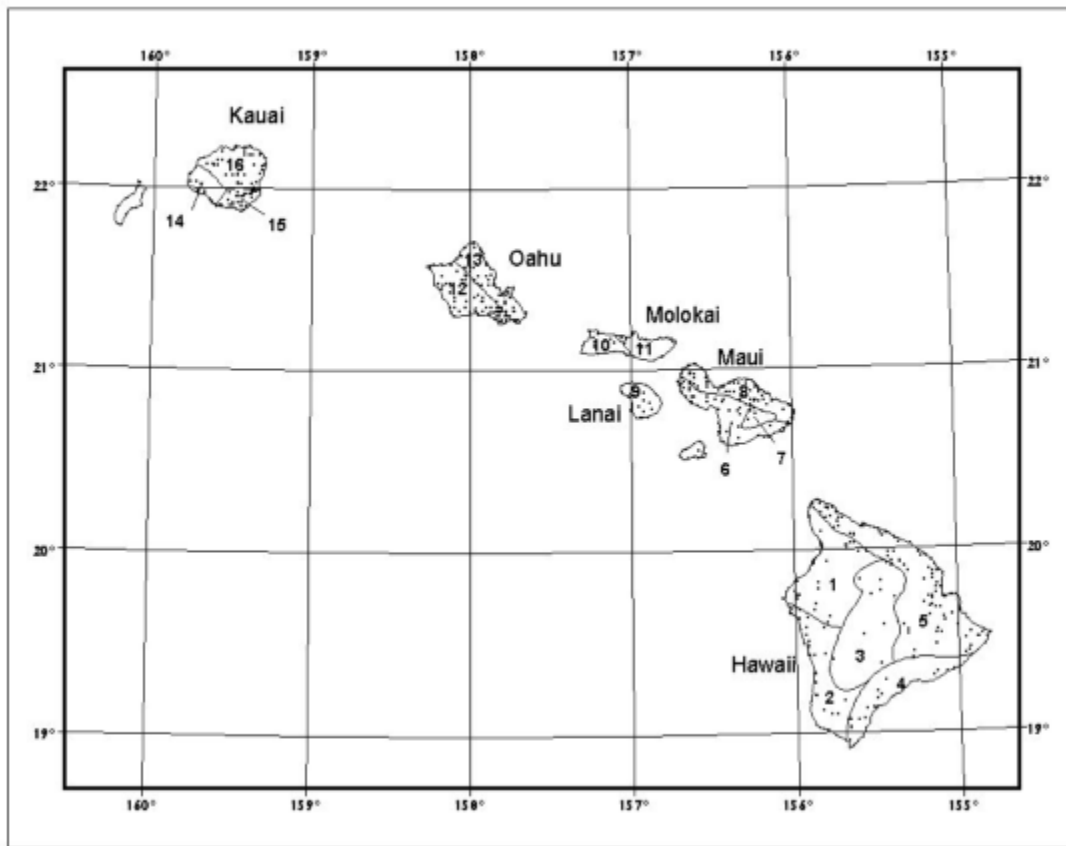


Figure 1. Hawaii Precipitation Frequency Project area, preliminary regional divisions and daily station locations.

## 2. Highlights

Available n-minute and 15-minute data were downloaded and formatted through 12/2005. Quality control of values above thresholds and of the annual maximum dataset using *QCseries* was completed on the 1-day, 2-day and 1-hour durations and nearly completed on the 24-hour, 48-hour and 2-hour durations. Additional information is provided in Section 3.1, Data Collection and Quality Control.

36 sets of daily rainfall stations meeting specific distance, elevation and period of record criteria were merged during the past quarter. Additional information is provided in Section 3.2, Station Merges.

HDSC continuously monitors the hits, integrity and performance of the Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information. Additional information is provided in Section 3.3, PFDS.

Work continues on the development of geographically fixed Areal Reduction Factors (ARFs) for area sizes of 10 to 500 square miles and durations of 30-minutes to 48-hours for the United States. Additional information is provided in Section 3.4, Areal Reduction Factors.

On June 19<sup>th</sup>, 2006 HDSC released NOAA Atlas 14 Volume 1 Version 4, Precipitation Frequency Estimates for the Semiarid Southwest United States including Arizona, Southeast California, Nevada, New Mexico, and Utah. This is an update to Volume 1 Version 3. Additional information is provided in Section 4.3, Update of NOAA Atlas 14 Volumes 1 and 2.

On June 28<sup>th</sup>, 2006 HDSC published NOAA Atlas 14 Volume 3, Precipitation Frequency estimates for Puerto Rico and the U.S. Virgin Islands. Additional information is provided in Section 4.4, Publication of NOAA Atlas Volume 3.

### 3. Progress in this Reporting Period

#### 3.1 Data Collection and Quality Control

**Data Collection.** HDSC downloaded and reformatted the NCDC 15-minute, n-minute and Automated Surface Observing System (ASOS) 1-minute data through 12/2005. In addition, 15-minute data from the Hydronet network were also downloaded and formatted through 12/2005. These data was accumulated to 60-minute summations so they can be efficiently quality controlled using QCseries by comparing with 1-hour data. Table 1 lists the n-minute/1-minute stations in Hawaii. Table 2 lists the NCDC 15-minute stations.

Table 1. N-minute/1-minute station metadata.

Station Name	ID number	Latitude	Longitude	Elevation (feet)	Start date	End date
HILO INTERNATIONAL AP	51-1492	19.7222	155.0558	38	06/1998	12/2005
HONOLULU INTL AP 703	51-1919	21.3219	157.9253	7	01/1984	12/2005
KAHULUI WSO AP 398	51-2572	20.8997	156.4286	51	01/1984	12/2005
LIHUE WSO AP 1020.1	51-5580	21.9839	159.3406	100	01/1973	12/2005

Table 2. NCDC 15-minute station metadata.

Station Name	ID number	Latitude	Longitude	Elevation (feet)	Start date	End date
AHUIMANU LOOP 839.12	51-0055	21.4319	157.8372	240	5/1971	12/2005
ALEXANDER RESV 983	51-0140	21.9600	159.5319	1610	12/1976	10/1997
ANAHOLA 1114	51-0145	22.1322	159.3039	180	7/1977	11/2001
CAMP 84 807	51-0300	21.4278	158.0611	760	1/1978	12/2005
DOWSETT 775.4	51-0404	21.3372	157.8344	390	9/1983	12/2005
DOWSETT HIGHLANDS 780.	51-0438	21.3500	157.8333	565	5/1971	11/1985
ELIMA RESV 985.2	51-0485	21.9356	159.5389	760	8/1994	12/2005
FIELD 46 474	51-0541	20.9889	156.6275	1050	2/1978	11/2005
HALAWA SHAFT 771.2	51-0964	21.3811	157.9042	170	5/1972	12/2005
HANA 354	51-1122	20.7500	155.9833	121	2/1976	2/1979
HANA AIRPORT 355	51-1125	20.7972	156.0169	75	3/1979	7/2005
HANAHANAPUNI 1055.2	51-1140	22.0303	159.4158	580	7/1977	12/2005
HAWAII VOL NP HQ 54	51-1303	19.4331	155.2594	3971	11/1976	12/2005
HAWAII KAI G.C. 724.19	51-1308	21.2992	157.6647	21	9/1977	12/2005
HAWI 168	51-1339	20.2436	155.8414	580	10/1976	12/2005
HELEMANO INTAKE 881	51-1384	21.5500	158.0000	1270	6/1978	4/1979
HAW'N OCN VIEW EST 3.9	51-1385	19.1222	155.7886	2900	8/1980	12/2005
HILO COUNTRY CLUB 86.	51-1487	19.6833	155.1667	1600	5/1973	3/1982
HOKULOA 725.2	51-1540	21.3906	158.0997	2260	3/1978	12/2005
HONOMU MAUKA 138	51-1960	19.8500	155.1500	1100	5/1973	10/1993
HUEHUE 92.1	51-2156	19.7567	155.9744	1960	3/1986	12/2005
KAAUHUHU	51-2270	20.2000	155.8333	1801	2/1986	2/1987
KAHAKULOA MAUKA 482.3	51-2453	20.9892	156.5478	650	2/1978	12/2005

Station Name	ID number	Latitude	Longitude	Elevation (feet)	Start date	End date
KAHIAWAI MAUKA 3.8	51-2512	19.1333	155.7667	4124	2/1978	12/1980
KAHUKU 912	51-2570	21.6950	157.9803	15	2/1978	12/2005
KAHUNA FALLS 138.2	51-2595	19.8614	155.1636	1390	10/1993	12/2005
KAHUA RANCH HQTRS 176.3	51-2600	20.1275	155.7914	3240	1/1978	12/2005
KAILUA FIRE STN 791.3	51-2683	21.3961	157.7394	10	10/1976	12/2005
KALAOA 69.22	51-2887	19.7333	155.9833	2000	9/1981	2/1986
KAMUELA 1 201.2	51-3072	20.0428	155.6111	2880	6/1981	12/2005
KANALOHULUHULU 1075	51-3099	22.1297	159.6586	3600	8/1978	12/2005
KAPAA STABLES 1104	51-3159	22.0856	159.3361	175	6/1973	12/2005
KAUMANA 88.1	51-3510	19.6800	155.1433	1180	4/1982	12/2005
KAUNAKAKAI MAU 536.5	51-3547	21.0950	157.0178	70	7/1978	12/2005
KAUPAKULUA 435.3	51-3562	20.8847	156.2864	1400	12/1988	12/2005
KAUPO RANCH 259	51-3576	20.6514	156.1386	1020	10/1976	12/2005
KEAIWA CAMP 22.1	51-3925	19.2386	155.4839	1700	7/1977	12/2005
KEALAKEKUA 26.2	51-3977	19.4947	155.9147	1480	8/1977	4/1978
KEALAKEKUA 3 29.11	51-3985	19.5167	155.9167	1530	6/1978	10/1986
KEALAKEKUA 4 74.8	51-3987	19.5136	155.9244	1420	11/1986	12/2005
KEANAKOLU CAMP 124.2	51-4098	19.9217	155.3425	5280	8/1977	12/2005
KEAWAKAPU BEACH 260.2	51-4193	20.7000	156.4500	20	10/1978	3/1983
KEKAHA 944	51-4272	21.9703	159.7111	9	8/1978	12/2005
KEPUHI-SHERATON 550.2	51-4400	21.1833	157.2464	140	1/1990	12/2005
KIHALANI 132.5	51-4459	19.9728	155.2394	990	10/2001	12/2005
KII-KAHUKU 911	51-4500	21.6953	157.9772	15	7/1979	1/1990
KILAUEA 1134	51-4561	22.2139	159.4044	320	8/1978	12/2005
KONA AIRPORT 68.3	51-4764	19.6500	156.0167	30	9/1977	8/1981
KUALAPUU 534	51-4778	21.1539	157.0369	825	11/1977	12/2005
KULA BRANCH STN 324.5	51-5000	20.7617	156.3242	3050	5/1979	12/2005
KULA HEIGHTS 323.2	51-5003	20.7833	156.3167	2523	2/1972	4/1977
LAHAINA 361	51-5177	20.8842	156.6806	40	10/1977	10/2001
LALAMILO FLD OF 191.1	51-5260	20.0117	155.6797	2615	1/1978	12/2005
LANAI CITY 672	51-5286	20.8292	156.9203	1620	11/1977	12/2005
LAUPAHOEHOE 133.1	51-5427	19.9878	155.2408	460	11/1993	9/2001
LAVA TREE PARK 66.1	51-5460	19.4833	154.9000	-999	11/1976	10/1978
LIHUE VRTY STA 1062.1	51-5560	22.0242	159.3867	380	7/1977	12/2005
LUALUALEI 804	51-5647	21.4214	158.1353	113	1/1974	9/1976
LULUKU 781.7	51-5655	21.3875	157.8094	280	5/1971	12/2005
MAKAHA CTRY CLUB 800.3	51-5758	21.4783	158.1964	250	12/1987	12/2005
MAKAHA PUMP 800.2	51-5782	21.4833	158.2000	400	2/1978	11/1987
MAKENA GOLF CRS 249.1	51-5842	20.6450	156.4433	100	8/1982	12/2005
MAUNAWILI 787.1	51-6222	21.3508	157.7667	395	2/1978	12/2005
MOUNTAIN VIEW #3 91.9	51-6546	19.5333	155.1333	1915	10/1990	11/1998
MOUNTAIN VIEW 91	51-6552	19.5525	155.1128	1530	7/1978	9/1985
MOUNT KAALA 844	51-6553	21.5025	158.1489	4025	3/1978	12/2005



Station Name	ID number	Latitude	Longitude	Elevation (feet)	Start date	End date
MOUNTAIN VIEW NO 2	51-6560	19.5333	155.1000	1580	9/1985	12/1989
OOKALA 223	51-7131	20.0167	155.2833	430	7/1978	10/1993
OPAEULA 870	51-7150	21.5786	158.0414	1000	10/1977	12/2005
PAAKEA 350	51-7194	20.8169	156.1219	1260	10/1977	12/2005
PAAUHAU 217	51-7204	20.0833	155.4333	415	6/1977	9/1994
PAAUHAU MAUKA 217.2	51-7209	20.0731	155.4472	1120	10/1994	12/2005
PAHOA SCHOOL SITE 64	51-7465	19.4939	154.9456	683	1/1979	12/2005
PEARL CTRY CLUB 760.2	51-7942	21.3933	157.9328	220	9/1977	12/2005
PEAHI 488.6	51-7952	20.9000	156.2833	830	10/1977	3/1989
POHAKULOA 107	51-8063	19.7528	155.5294	6511	10/1976	12/2005
PH WAINIHA 1115	51-8155	22.1961	159.5561	101	6/1973	12/2005
PRINCEVILLE RANCH 1117	51-8165	22.2181	159.4828	217	8/1978	12/2005
PRI WAHIAWA 820.2	51-8172	21.4667	158.0167	702	5/1972	8/1976
PUNALUU PUMP 905.2	51-8314	21.5844	157.8914	20	6/1972	12/2005
PUPUKEA HEIGHTS 896.4	51-8342	21.6408	158.0364	750	5/1971	12/2005
PUUKOLII 457.1	51-8407	20.9319	156.6761	420	7/2002	12/2005
PUU-O-HOKU RANCH 542.1	51-8549	21.1436	156.7347	700	11/1977	12/2005
PUU WAAWAA 94.1	51-8555	19.7811	155.8458	2520	1/1978	12/2005
TANTALUS PEAK 780	51-8730	21.3333	157.8167	2001	5/1971	1/1977
UNIV OF HAWAII AGR RES CN	51-8743	20.7667	156.3333	3051	5/1977	4/1979
ULUPALAKUA RANCH 250	51-8760	20.6519	156.4008	1900	2/1972	12/2005
WAHIAWA 930	51-8941	21.8967	159.5569	215	8/1978	12/2005
WAHIAWA DAM 863	51-8945	21.4967	158.0497	854	8/1977	12/2005
WAIHAOLE 837	51-8964	21.4739	157.8839	745	11/1977	12/2005
WAIAMI UPPER 1052	51-8966	22.0219	159.4644	780	6/1987	12/2005
WAIALUA 847	51-9195	21.5744	158.1206	32	1/1978	12/2005
WAIANAE KAIWIWI 801.1	51-9234	21.4569	158.1803	40	11/1972	7/1977
WAIKAMOI DAM 336	51-9335	20.8122	156.2328	4320	10/1976	12/2005
WAIKAPU 390	51-9376	20.8522	156.5122	425	7/1979	12/2005
WAILUPE VALLEY SCH 723.6	51-9500	21.2919	157.7525	180	10/1977	12/2005
WAIMANALO NONOKIO 795.2	51-9534	21.3356	157.7114	120	11/1972	12/2005
WAIMA 892	51-9593	21.6261	158.0678	330	11/1977	12/2005

**Data Quality Control.** Erroneous observations were eliminated from the daily and hourly datasets through a check of extreme values above thresholds. The thresholds were established for 1-hour and 1-day values based on climatological factors and previous precipitation frequency estimates in a given region. Observations above these thresholds were checked against nearby stations, original records and other climatological bulletins. During this quarter, the extreme-over-threshold check for the 1-hour and state-entered 1-day data was completed. Four gross errors in the 1-hour data were found and corrected from this check.

*QCseries*, an objective technique that performs a spatial and statistical evaluation against concurrent data at nearby stations was used to quality control the annual maximum series (AMS) data for the 1-day, 2-day, and 1-hour durations. Values flagged by *QCseries* were investigated further against scanned and paper records, nearby stations, surrounding durations and publications such as “Storm Data” to determine their validity. Quality control of the 2-hour, 24-hour and 48-hour durations using *QCseries* was also begun.

This quarter a total of 2,258 values were quality controlled and from this 694 corrections were made to the dataset. A majority of these corrections were where an accumulated value not flagged as such and preceded either by missing flags or zero values. Other types of errors found included: erroneous values, monthly or weekly totals listed as daily totals and incorrect dates. These errors will be sent to NCDC upon completion of the remaining quality control. The details of the quality control are summarized in Table 3.

Table 3. Summary of the quality control done this quarter.

Dataset	Number of values quality controlled	Number of corrections made
1-day	1,721	645
1-hour	346	7
2-day	191	42
Total	2,258	694

### 3.2 Station Merges

Daily stations in the project area within 1.5 miles in horizontal distance and 1,000 feet in elevation with non-concurrent records were considered for merging to increase record length and reduce spatial overlaps. The 1-day annual maximum series of candidate stations were tested using a statistical t-test to ensure the samples were from the same population and appropriate to be merged. In addition, the candidates could not have a gap or overlap in the period of record of more than 5 years. Initially, criteria of 1 mile in horizontal distance and 100 feet in elevation was considered but ultimately increased to 1.5 miles and 1,000 feet because there were so few candidates (47) and all but 3 passed the t-test. However, most stations merged were within 1 mile and 500 feet.

In total, 136 station pairs met the criteria and 113 pairs passed the t-test. Of the 113 pairs, 36 groups of daily stations were merged after meeting all criteria including local climatology and visual inspection on a station map. Of these 36 mergers, 31 were pairs (Table 4) and 5 were 3-station groups (Table 5).

Table 4. Station pairs that were merged.

Station 1 (ID - Name)	Station 2 (ID - Name)
51-1598 HOMESTEAD FIELD 524	51-6534 MOLOKAI AP 524
51-8905 WAHIAWA 872	51-9795 WHEELER AAF 810.1
51-9800 WHEELER	53-0058 OHAU 00-081401
53-0113 OHAU 00-085400	53-0123 OHAU 00-088800
51-2683 KAILUA FIRE STN 791.3	53-0100 OHAU 00-079070
51-5785 MAKAHUENA POINT 940.1	51-4748 KOLOA LN MAK 940.1
51-6537 MOLOKOA 1015	53-0197 KAUAI 00-101600
51-0344 CITY OF REFUGE 27.4	51-8552 PUUHONUA-O-HONAUNAU 27.4
51-7421 PAHALA 21	51-7437 PAHALA MAUKA 21.3
51-4928 KUKUIHAELE HIC 199	51-4927 KUKUIHAELE 206.1
51-0260 CAMP K 3 HCS 313	53-0134 MAUI 00-031320
51-2317 KAAPALI AP 453.1	51-2307 KAAPALI AIRPORT 453.1
51-5006 KULA SANATORIUM 267	51-5004 KULA HOSPITAL 267
51-0232 BLACK POINT 717	51-9397 WAIKIKI 717.2
53-0074 OHAU 00-087310	51-8838 UPPER WAHIAWA 874.3
51-1527 HOAEAE UPPER	53-0064 OHAU 00-080600
51-1593 HOMESTEAD 985	53-0252 KAUAI 00-092800
51-6546 MOUNTAIN VIEW #3 91.9	51-0746 GLENWOOD NO 2 55.4
51-7204 PAAUHAU 217	51-7209 PAAUHAU MAUKA 217.2
51-8559 PUUOMALEI	51-0995 HALEAKALA EXP FARM 434
51-8601 ST STEPHEN'S SEMINARY	53-0075 OHAU 00-079060
51-8577 RESERVOIR 9 307	51-8060 POHAKEA BRIDGE 307.2
51-5781 MAKAHA VALLEY 800.1	51-5782 MAKAHA PUMP 800.2
51-1562 HOLUALOA BEACH 68	51-2686 KAILUA HEIGHTS
51-4632 KIPA	51-0150 AMAUULU 89.2
51-8378 PUUKAELE RESERVOIR 1135	51-4566 KILAUEA FIELD 17 1135
51-3754 KAWAIILOA	53-0116 OHAU 00-089000
51-0300 CAMP 84 807	53-0090 OHAU 00-080930
51-8126 PORTLOCK ROAD 724.4	51-7540 PAIKO DRIVE 723.4
53-0082 OHAU 00-077160	51-0123 AIEA HEIGHTS 764.6
51-1370 HEEIA	51-3113 KANEOHE MAUKA 781

Table 5. 3-station groups that were merged.

Station 1 (ID - Name)	Station 2 (ID - Name)	Station 3 (ID - Name)
51-8734 TANTALUS 714	51-8736 TANTALUS MAUKA	51-8738 TANTALUS 2 780.5
51-5213 LAIE 903	51-0340 CHURCH COLLEGE LAIE	51-0242 B Y U LAIE 903.1
51-9593 WAIMEA 892	53-0127 OHAU 00-089200	51-9603 WAIMEA ARBORETUM 892.2
51-6228 MAUNAWILI RANCH	51-3123 KANEOHE RANCH 838	51-7656 PALI GOLF COURSE 788.1
51-3047 KAMAOA 5	51-3048 KAMAOA 2 5	51-3054 KAMAOA PUUEO 5.1

### 3.3 PFDS

The Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information, did not undergo any significant changes this quarter.

HDSC continuously monitors the hits, integrity and performance of the PFDS, which continues to receive a steady number of hits per month. The graph (Figure 2) below summarizes the number of individual data inquiries made since June 2004, while the map (Figure 3) indicates the locations of inquiries during the past quarter.

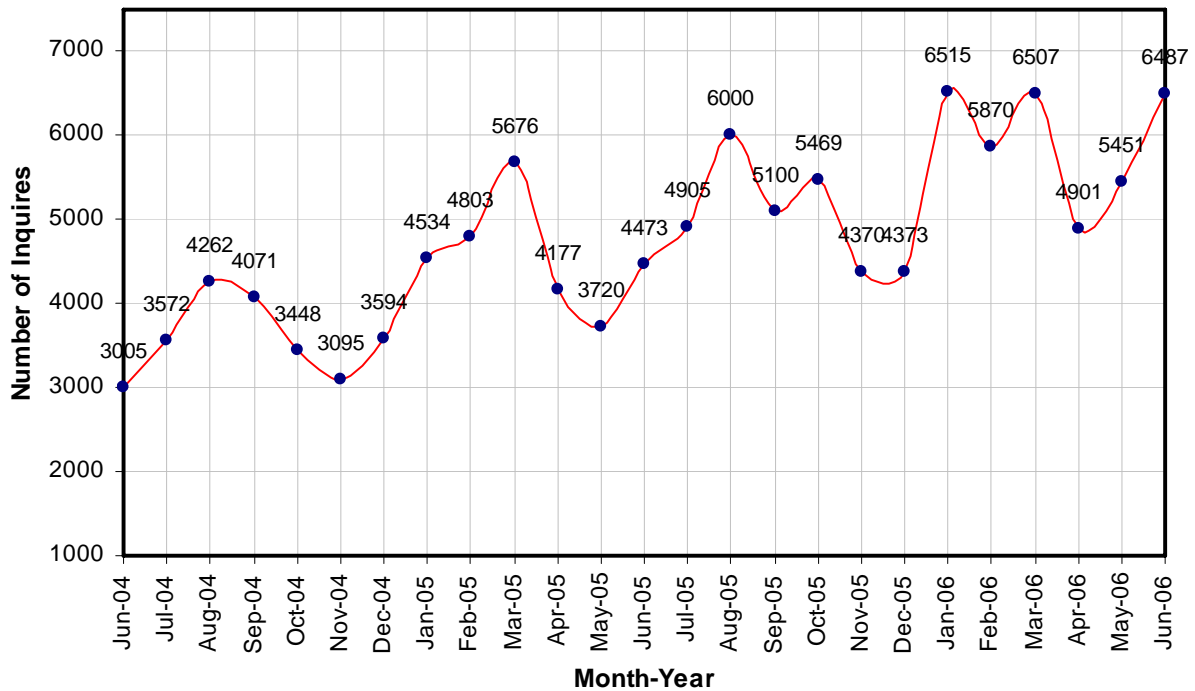


Figure 2: Number of individual PFDS data inquiries per month.

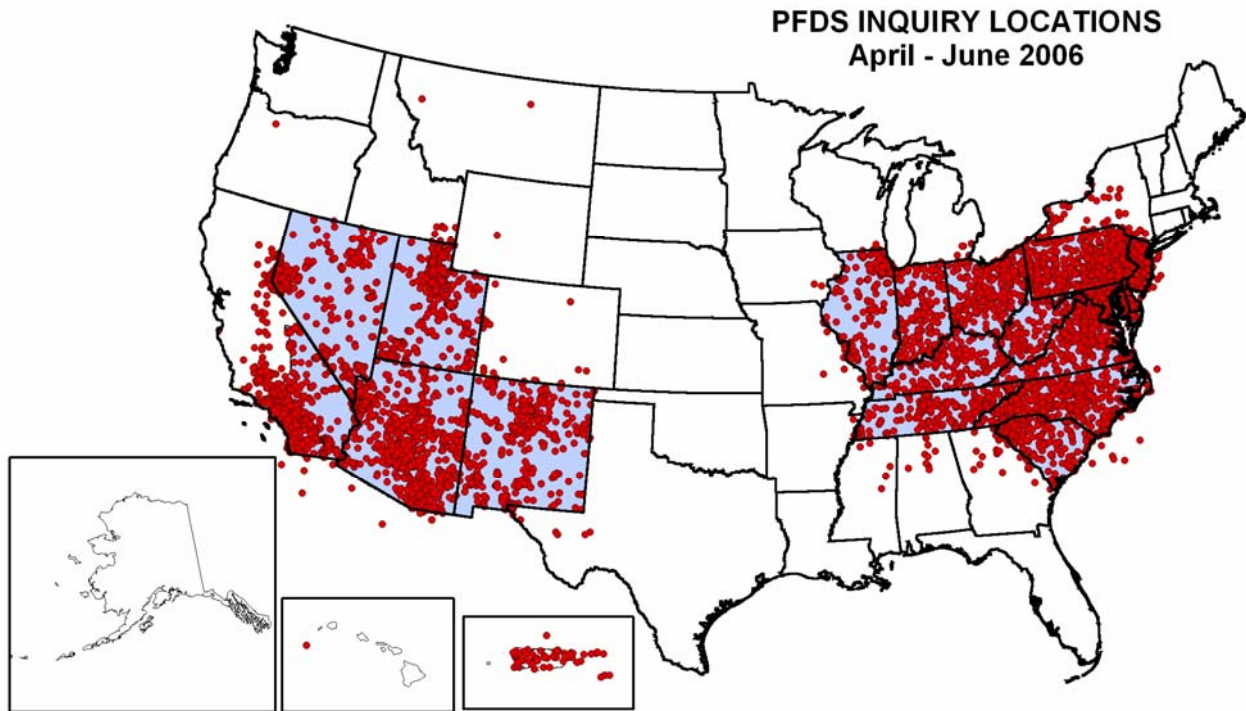


Figure 3: Map of 16,839 PFDS data inquiry locations during the period April-June 2006.

### 3.4 Areal Reduction Factors

Work continues in the development of geographically fixed Areal Reduction Factors (ARFs) for area sizes of 10 to 500 square miles and durations of 30-minutes to 48-hours for the United States. The results of this supplementary study will be applicable to all volumes of NOAA Atlas 14.

Although ARF software development has been slow, it continues to move forward. The continuing goal is to develop ARF software based on the NOAA Technical Report NWS 24 (Myers, V.A. and R.M. Zehr, 1980) methodology and obtain the same results published in TR-24 for the Chicago rain gauge network. The ARF computations are a function of six variables that vary in time and space. Fitting functions (curves) to these six variables so that the results are equal to those in TR-24 has been difficult.

Figure 4 shows the locations of all used, not used and considered rain gauge networks. Table 6 provides additional details of the preliminary study areas. After an exhaustive search for quality rain gauge networks that meet certain criteria (10+ years of concurrent hourly precipitation data at 10+ gauges over an area of ~100 to ~500 square miles), HDSC is no longer actively seeking additional networks unless user provided. Networks in Alaska, Puerto Rico and Hawaii were investigated but found insufficient.

Figure 4. Map of ARF study areas.

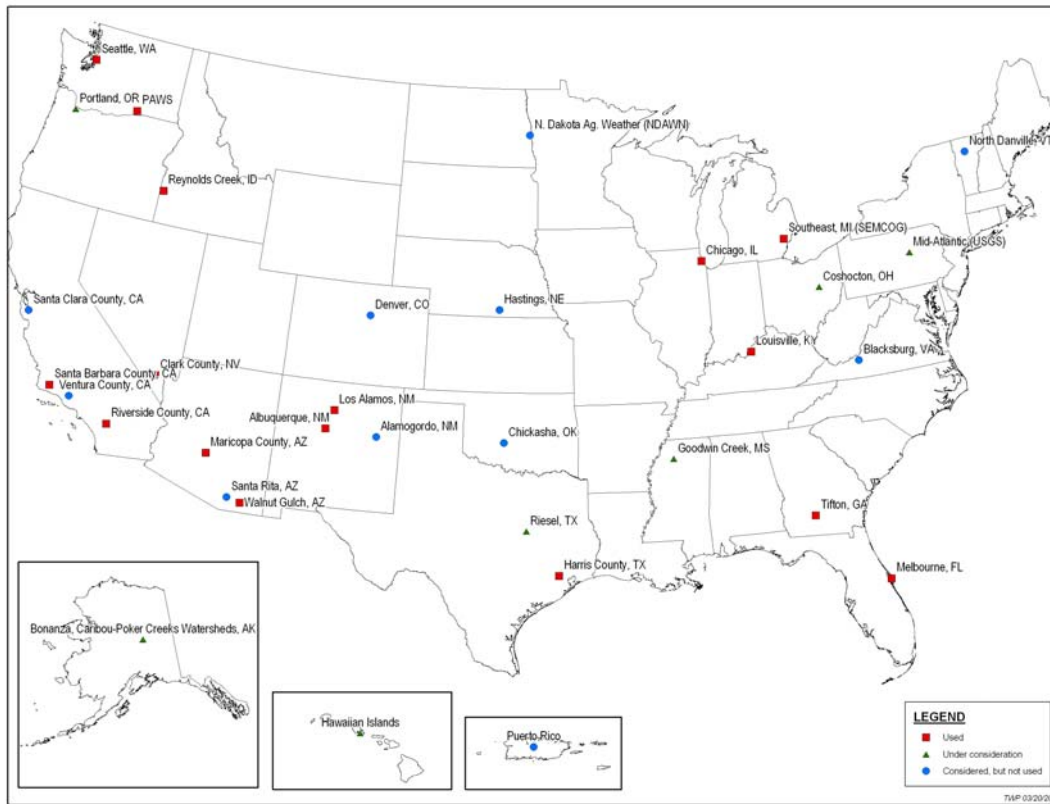


Table 6. Preliminary ARF study areas.

Study area location	Included	Date range	~Size (sq-mi)	Stations	Lat	Lon	Elev. (ft)
Albuquerque, NM	Yes	1978-1992	400	13	35.161	-106.566	5311
Chicago, IL	Yes	1949-1980	n/a	18	41.830	-87.692	618
Clark County, NV	Yes	1990-2004	n/a	48	36.290	-114.978	940
Los Alamos, NM	Yes	1990-2005	150	9	35.858	-106.282	7011
Maricopa county, AZ	Yes	1980-2001	n/a	31	33.789	-112.303	2572
Reynolds Creek, ID	Yes	1962-1996	n/a	44	43.169	-116.769	5342
Riverside county, CA	Yes	1961-2001	n/a	45	33.793	-116.995	1987
Santa Barbara, CA	Yes	1968-2003	n/a	38	34.590	-119.957	1203
Seattle, WA	Yes	1978-2003	216	23	47.553	-122.333	152
South-central Washington state (PAWS)	Yes	1989-2005	700	15	46.071	-119.306	765
Southeast Michigan (SEMCOG)	Yes	1988-2002	n/a	50	42.518	-83.286	730
Melbourne, FL	Yes	1997-2005	450	35	28.545	-80.634	0
Harris County, TX	Yes	1997-2005	3800	165	29.779	-95.405	n/a
Walnut Gulch, AZ	Yes	1954-1996	n/a	107	31.728	-110.024	4656
Chickasha (Micronet), OK	Maybe	1994-2005	1130	44	34.885	-98.075	398
Coshocton, OH	Maybe	1940-2001	n/a	22	40.435	-81.799	1044
Goodwin, MS	Maybe	1981-1996	n/a	32	34.232	-89.914	333
Jefferson County, KY	Yes	1990-2006	n/a	18	38.190	-85.670	n/a
Portland, OR	Maybe	1976-2005	200	45	45.537	-122.662	n/a
Tifton, GA	Maybe	1968-1981	n/a	55	31.439	-83.590	n/a
Ventura, CA	Maybe	n/a	n/a	134	34.370	-119.067	n/a
Bonanza, Caribou-Poker Creeks Watershed(s), AK	No	n/a	50	n/a	64.750	-148.230	1641
Puerto Rico (eastern)	No	1973-2003	500	10-18	18.260	-65.910	800
Hawaii	No	~1948-2005	n/a	n/a	n/a	n/a	n/a

Study area location	Included	Date range	~Size (sq-mi)	Stations	Lat	Lon	Elev. (ft)
Alamogordo Creek, NM	No	1955-1962	67	64	34.920	-104.143	4898
Blacksburg, VA	No	n/a	n/a	<10	37.250	-80.417	n/a
Denver, CO	No	n/a	n/a	n/a	39.750	-105.000	n/a
Ft. Collins, CO	No	1999-2005	12		40.567	-105.093	5099
Riesel, TX	No	n/a	10	39	31.482	-96.880	544
Hastings, NE	No	1938-1967	n/a	19	40.255	-98.376	n/a
North Danville, VT	No	1958-1975	n/a	27	49.678	-74.724	2118

## 4. Issues

### 4.1 New Employee

Daniel Brewer, a Science Applications International Corporation (SAIC) contractor, joined HDSC on April 10<sup>th</sup>, 2006 on a temporary basis during the absence of Debbie Martin on maternity leave. Dan has a degree in Meteorology from Millersville University in Millersville, PA.

### 4.2 California Precipitation Frequency Project

The state of California and others have committed to funding a project to update the precipitation frequency estimates for the remaining portion of California. Agencies involved include CA Department of Transportation, CA Department of Water Resources, NOAA Coastal Storms Program, and U.S. Army Corps of Engineers.

HDSC is in the process of formalizing an agreement with the California Department of Water Resources for the work. HDSC will update precipitation frequency estimates for the remainder of California not covered by NOAA Atlas 14 Volume 1. By the end of September 2006, HDSC will obtain all relevant NCDC rain gauge data. In addition, HDSC will begin to identify other non-NCDC data, such as ALERT data for possible inclusion in the project.

### 4.3 Update of NOAA Atlas 14 Volumes 1 and 2

On June 19<sup>th</sup>, 2006 HDSC released NOAA Atlas 14 Volume 1 Version 4, an update to Version 3. Volume 1 contains precipitation frequency estimates for the Semiarid Southwest United states including Arizona, Southeast California, Nevada, New Mexico, and Utah.

The Version 4 update represents an enhanced product that has added estimates for the 1-year average recurrence interval (ARI) and has extended the domain to include the entire Lake Tahoe basin. In addition, it incorporates some enhanced algorithms based on lessons learned in creating the newest volume, Volume 3 (Puerto Rico and the U.S. Virgin Islands). Each of the additions and enhancements were objectively justified and based on sound science. The enhancements include improved spatial interpolation when using the inverse-distance-weighting function, improved consistency adjustments for co-located daily and hourly stations and for hourly-only stations, and an improvement to the 24-hour confidence limits. An Addendum is available to provide additional details. It is available on our web site:

[http://hdsc.nws.noaa.gov/hdsc/pfds/docs/NOAA\\_Atlas\\_14\\_Volume1\\_Version4\\_Addendum.pdf](http://hdsc.nws.noaa.gov/hdsc/pfds/docs/NOAA_Atlas_14_Volume1_Version4_Addendum.pdf)

Final associated documentation will be updated accordingly and released in the next quarter.



NOAA Atlas 14 Volume 2, precipitation frequency estimates for the Ohio River Basin and surrounding states will be updated during the next quarter with the same additions and enhancements.

#### 4.4 Publication of NOAA Atlas Volume 3

On June 28<sup>th</sup>, 2006 HDSC published NOAA Atlas 14 Volume 3, Precipitation Frequency estimates for Puerto Rico and the U.S. Virgin Islands. The estimates are available as a web based publication through the Precipitation Frequency Data Server (PFDS) on the HDSC web site at: <http://hdsc.nws.noaa.gov/hdsc/pfds/index.html>. Final documentation for the project will be published in the next quarter.

### 5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks that will be worked on during the next few quarters are also included in this section.

- Data Collection and Quality Control [August 2006]
- L-Moment Analysis/Frequency Distribution [October 2006]
- Trend Analysis [September 2006]
- Temporal Distributions of Extreme Rainfall [October 2006]
- Peer Review of estimates [November 2006]
- Spatial Interpolation [February 2007]
- Precipitation Frequency Maps [March 2007]
- Web Publication [February 2007]
- Documentation [April 2007]

- Areal Reduction Factors [October 2006]

#### 5.1 Data Collection and Quality Control.

Quality control of the 24-hour duration will be completed during the next quarter. In addition, long duration annual maximums (4-day through 60-day durations) and short durations (2-hour through 48-hour durations) and n-minute data will be quality controlled using *QCseries* and by checking extremes above thresholds, among other methods. Annual maximum series records will be checked for statistical consistency if large gaps in time exist. Conversion factors (1-day to 24-hour, 2-day to 48-hour, 1-hour to 60-minute and 2-hour to 120-minute) will be calculated.

## 5.2 L-Moment Analysis

Work will begin to create homogeneous precipitation frequency regions for the L-Moment analysis of the 24-hour data. The initial daily regions (Figure 1), which are based primarily on climatology, will be used as a starting point.

## 5.3 Trend Analysis

Once the data have been quality controlled, an analysis for trends in the annual maximum time series will commence.

## 5.4 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 14 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

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